PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
M02B123/MW		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/GB 03/03077	14.07.2003	16.07.2002
International Patent Classification (IPC) or both national classification and IPC		
C23C8/12		
Applicant		
THE BOC GROUP PLC et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 4 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 2 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the opinion
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
09.02.2004	13.05.2004
Name and mailing address of the international preliminary examining authority:	Authorized Officer
European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Badcock, G Telephone No. +49 89 2399-8445

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB 03/03077

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:

Description, Pages

1-11 as originally filed

Claims, Numbers

1-6 received on 30.04.2004 with letter of 30.04.2004

Drawings, Sheets

1/3-3/3 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).

   ☐ the language of publication of the international application (under Rule 48.3(b)).

   ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   ☐ contained in the international application in written form.

   ☐ filed together with the international application in computer readable form.

   ☐ furnished subsequently to this Authority in written form.

   ☐ furnished subsequently to this Authority in computer readable form.

   ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

   ☐ the description, pages:

   ☐ the claims, Nos.:

   ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-6
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-6
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-6
	No:	Claims	

2. Citations and explanations

   see separate sheet

1). Relevant documents

D1: WO-A-9904055

2). Novelty, Art.33(2) PCT

According to the method of present claim 1, the article is heat treated for at least 12 hours in an atmosphere in which the molecular oxygen concentration is controlled to be in the range of 10-400 volumes per million in the inert carrier gas. In D1 the article is first heated in air for a short period of time of 0.1-1 hour, and then heat treated in a vacuum or inert atmosphere for 0.5-50 hours to cause oxygen from the oxide layer to diffuse into the article. Hence the claimed process is distinct from that disclosed in D1. The process of claim 1 is novel.

3). Inventive step, Art.33(3) PCT

Starting from the closest prior art, D1, the problem may be considered to be the provision of a method which is more controllable and to give a more reliable hardness profile in the final article. Replacing the two stage process according to D1 with one in which the concentration of oxygen is controlled within the stipulated limits of 10-400 volumes per million is not derivable from the prior art.
The method of claim 1 is considered inventive.

4). Industrial Applicability Art.33(4) PCT

The claims relate to a process which is industrially applicable.

CLAIMS

1. A method of case hardening an article of titanium or a titanium-based alloy, or of zirconium or a zirconium-based alloy, wherein the article is heat treated for a period of at least 12 hours at one or more temperatures in the range of 850°C to 900°C and at a pressure in the order of atmospheric pressure in an oxygen diffusion atmosphere comprising

   a) a carrier gas which does not react chemically with the article in the said temperature range and

   b) molecular oxygen, wherein the concentration of oxygen in the oxygen diffusion atmosphere is in the range of 10 volumes per million to 400 volumes per million.

2. A method as claimed in claim 1, in which the oxygen concentration is in the range of 75 to 300 volumes per million.

3. A method as claimed in claim 2, in which the oxygen concentration is in the range of 100 to 200 volumes per million.

4. A method according to any one of the preceding claims, in which the case hardened article is subjected to a further heat treatment at a temperature in the range of 500 to 900°C in an atmosphere having an oxygen concentration of at least 5000 volumes per million so as to form a visible surface oxide layer on the article that improves its tribological properties.

5. A method as claimed in claim 4, in which the atmosphere in which the tribological surface oxide layer is formed contains from 15 to 25% by volume of oxygen and from 75 to 85% by volume of argon.

6. A method as claimed in any one of the preceding claims, in which the said carrier gas is argon.

5